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Subject: Analysis of Federal PTC Extension Scenarios for Wind Power

PURPOSE

In this brief memorandum we summarize our analysis of the potential impacts of various federal production tax credit (PTC) extension scenarios on wind economics and expected capacity additions. Three specific scenarios are considered:

1. no extension of the federal PTC for wind power,
2. a three year extension of the PTC for wind power through 2006, *with* the current inflation adjustment, and
3. a three year extension of the PTC for wind power through 2006, *without* the inflation adjustment.

Three-year extension cases were selected due to the relevance of these cases to current energy bill discussions in the U.S. Congress. We also conduced two additional cases to explore the potential impact of even lower PTCs, in order to test the sensitivity of the model.

We find that the direct value of the PTC to wind project owners will be reduced by 7-11% if the inflation adjustment is eliminated. The Energy Information Administration's (EIA) 2003 version of the National Energy Modeling System (NEMS) predicts that extending the PTC for three years will have a substantial impact on wind plant capacity installations, regardless of whether the inflation adjustment is retained or eliminated. Capacity additions predicted by NEMS for the PTC extension cases, as presented in this memo, may be viewed as unrealistic by some. NEMS also predicts that eliminating the inflation adjustment will slow wind capacity installations, but not dramatically.

THE VALUE OF THE PTC

Before discussing the modeling analysis and results, it is first useful to review the direct value of the PTC to wind power projects, and the relative value of the PTC with and without the inflation adjustment.

The Energy Information Administration's (EIA) 2003 Annual Energy Outlook (AEO) assumes that the PTC's direct value to a wind project is 1.8¢/kWh in real, 2002 dollars over its 10-year term (assuming the inflation adjustment continues). This is true for all wind projects eligible for the inflation-adjusted PTC, regardless of installation date.[1]

Using the AEO 2003 GDP Chain-Type Price Index forecasts for inflation adjustments (available at: http://www.eia.doe.gov/oiaf/archive/aeo03/aeotab_20.htm), and assuming a 7% real discount rate, one can easily calculate the impact of the removal of the PTC inflation adjustment on the direct 10-year value of the PTC to wind project owners.

Unlike the inflation-adjusted PTC, the real $2002 value of a non-inflation adjusted PTC will depend on the year in which a wind project is installed. Projects installed later in time receive a PTC that has lower value in real 2002 dollars.

10-Tear Direct Value of PTC with Inflation Adjustment Intact (real $2002): 1.8¢/kWh
10-Year Direct Value of PTC with No Inflation Adjustment:

- year 2004 wind projects (real $2002) 1.67¢/kWh
- year 2005 wind projects (real $2002) 1.63¢/kWh
- year 2006 wind projects (real $2002) 1.60¢/kWh

Given a 3-year extension of the PTC, and assuming the EIA's inflation forecast, removal of the inflation adjustment reduces the 10-year direct value of the PTC to wind project owners by 7% (2004 projects), 9% (2005 projects), and 11% (2006 projects).

MODELING THE IMPACT OF PTC EXTENSION SCENARIOS

Berkeley Lab has the capability to run the AEO 2003 version of the EIA's National Energy Modeling System (NEMS). To evaluate the possible impacts of different PTC extension cases, Berkeley Lab ran NEMS under three basic scenarios:

1. No extension of the federal PTC for wind power, replicating the AEO2003 reference case projection released by the EIA.
2. A three year extension of the PTC for wind power through 2006, with the current inflation adjustment, assuming a 1.8¢/kWh ($2002) direct value of the PTC.
3. A three year extension of the PTC for wind power through 2006, without the inflation adjustment, assuming a 1.6¢/kWh ($2002) direct value of the PTC.

Several notes on methodology are in order. First, to simplify the analysis, we assume here that the PTC is *only* extended for wind power. Second, we chose to apply the 1.6¢/kWh ($2002)

[1] As discussed in AEO 2004, however, the effect of the PTC over a wind power project's lifetime is also affected by the countervailing influences of: (1) project lifetimes that exceed the 10-year duration of the PTC (typically 20-30 years), thereby diluting the 20-30 year levelized value of the PTC to something less than the 10-year value of 1.8¢/kWh real, and (2) the fact that the availability of the PTC allows a lower sales price for wind generated electricity, potentially further reducing necessary tax payments. EIA estimates that these influences net out to result in a 20-year "levelized value" of the PTC to wind project owners of ~2¢/kWh, where "levelized value" is defined as the plausible reduction in the sales price of wind generated electricity due to the existence of the PTC.

direct value of the PTC in the *no inflation adjustment* scenario for projects constructed in 2004, 2005, and 2006, despite the fact that projects installed in 2004 and 2005 will experience a somewhat higher value for the PTC (see previous section of this memo). We selected the 1.6¢/kWh ($2002) value because the 2003 version of NEMS does not easily allow for variations in the value of the PTC over time, and to conservatively show the potential effect of eliminating the inflation adjustment. Finally, we note that we fully utilized the integrated NEMS modeling output in our assessment. We have not independently evaluated these results to test them for reasonableness or consistency.

With these caveats, the results of our analysis follow:

Model Scenario	**Current Wind Capacity[2]**	**Projected U.S. Wind Power Capacity**		
	End of 2003	End of 2006	End of 2009	End of 2019
No PTC Extension (AEO 2003 Reference Case)	6.4 GW	7.6 GW	8.4 GW	10.9 GW
3-year PTC Extension with Inflation Adjustment (1.80¢/kWh, $2002)	6.4 GW	18.3 GW	19.6 GW	22.8 GW
3-year PTC Extension with No Inflation Adjustment (1.60¢/kWh, $2002)	6.4 GW	18.1 GW	19.2 GW	22.4 GW

The analysis projects that a three year extension of the PTC will have a significant effect on domestic wind power capacity, regardless of whether the inflation adjustment is retained or eliminated. 11.9 GW of wind is added by the end of 2006 in the three-year PTC case with an inflation adjustment, while 11.7 GW is added if the three-year extension does not include the inflation adjustment. Without an extension of the PTC, wind additions are expected to be modest (1.2 GW by 2007). Eliminating the inflation adjustment to the PTC has a negative impact on wind plant additions, but those effects are not overwhelming.[3]

Assuming that the inflation-adjusted PTC is extended for three years, 10.7 GW of incremental wind power capacity is expected by the end of 2006 relative to the AEO 2003 reference case of no PTC extension (18.3-7.6 GW). By the end of 2009, this incremental wind power capacity differential grows to 11.2 GW, and by the end of 2019 increases to 11.9 GW.[4] These expected

[2] Note that NEMS 2003 assumes that 6.8 GW of wind is installed at the end of 2003. 6.4 GW is the actual installed wind capacity, according to AWEA.

[3] Note that these capacity addition numbers are relative to a 6.4 GW starting point (the actual amount of installed wind capacity at the end of 2003), while AEO 2003 actually assumes a starting point of 6.8 GW.

[4] Note that the impact of the three-year PTC extension is expected to largely come in the form of increased wind capacity installation during the three-year extension period (2004-2006). However, relative to the reference case of no PTC extension, the amount of wind capacity installation increases modestly even after the PTC expires at the end of 2006 (i.e., the 10.7 GW at the end of 2006 increases to 11.9 GW by the end of 2019). Why NEMS predicts this modest continued increase is not clear, but may be the result of presumed learning economies in NEMS that result in lower wind costs with higher volumes of installation.

capacity additions are significant, and represent annual increases in wind capacity that are well beyond what the U.S. has experienced in any previous year. It also deserves note that these capacity increases come entirely in 2005 and 2006, with NEMS not predicting any incremental wind capacity additions in 2004 relative to the reference case. **We note that these simply represent NEMS output, and may be viewed as unrealistic by some.**

NEMS predicts that wind capacity installations will grow more slowly if the inflation adjustment to the PTC is eliminated. In particular, relative to the case in which the inflation adjustment is maintained, 0.2 GW *less* wind capacity is installed by the end of 2006 (18.3-18.1 GW), growing to 0.5 GW less by the end of 2009 and dropping to 0.4 GW less by the end of 2019.

It deserves note that the EIA, in AEO2004, also conducts PTC extension sensitivities, using NEMS 2004. EIA's cases differ somewhat from those tested in this memo, and are therefore not completely comparable. However, EIA did test the potential impacts of a 3-year extension of an inflation-adjusted PTC. EIA estimates that with a three-year extension of the inflation adjusted PTC, wind capacity installations will reach 9.8 GW by the end of 2006, 12.4 GW by the end of 2009, and 21.2 GW by the end on 2019. These EIA results are ***substantially different*** from those shown in this memo, and show much more modest wind capacity additions in the early years of the PTC extension, but much greater rates of growth after the PTC has expired in later years of the forecast. The reasons for these substantial discrepancies are unclear.

TESTING THE SENSITIVITY OF THE MODEL

To test the sensitivity of predicted wind capacity installations to the value of the PTC, we also ran two cases in which the real $2002 value of the PTC is decreased further, to 1.50¢/kWh and 1.20¢/kWh. These two scenarios do not reflect cases that are being considered at the federal level, but do allow one to further test the sensitivity of NEMS to the assumed value of the PTC. Results are presented below, along with the original results presented earlier:

Model Scenario	**Current Wind Capacity**	**Projected U.S. Wind Power Capacity**		
	End of 2003	End of 2006	End of 2009	End of 2019
No PTC Extension (AEO 2003 Reference Case)	*6.4 GW*	*7.6 GW*	*8.4 GW*	*10.9 GW*
3-year PTC Extension with Inflation Adjustment (1.80¢/kWh, $2002)	*6.4 GW*	*18.3 GW*	*19.6 GW*	*22.8 GW*
3-year PTC Extension with No Inflation Adjustment (1.60¢/kWh, $2002)	*6.4 GW*	*18.1 GW*	*19.2 GW*	*22.4 GW*
3-year PTC Extension with No Inflation Adjustment (1.50¢/kWh, $2002)	**6.4 GW**	**17.5 GW**	**18.6 GW**	**21.7 GW**
3-year PTC Extension with No Inflation	**6.4 GW**	**14.9 GW**	**16.0 GW**	**19.1GW**

Adjustment (1.20¢/kWh, $2002)

Relative to even a value as low as 1.60¢/kWh, the impact is non-negligible. In the 1.50¢/kWh case, end of 2006 wind capacity is predicted by NEMS to be 17.5 GW, growing to 18.6 GW by the end of 2009 and 21.7 GW by the end of 2019. In other words, even this small reduction in the value of the PTC (from 1.6¢/kWh to 1.5¢/kWh) further reduces expected wind capacity additions by ~0.6 GW. If the PTC's value is reduced even further, to 1.20¢/kWh, capacity installations drop by ~3.2 GW relative to the 1.60¢/kWh case. As such, we conclude that expected wind plant capacity installations in NEMS are somewhat sensitive to the value of the PTC.